FIG. 1

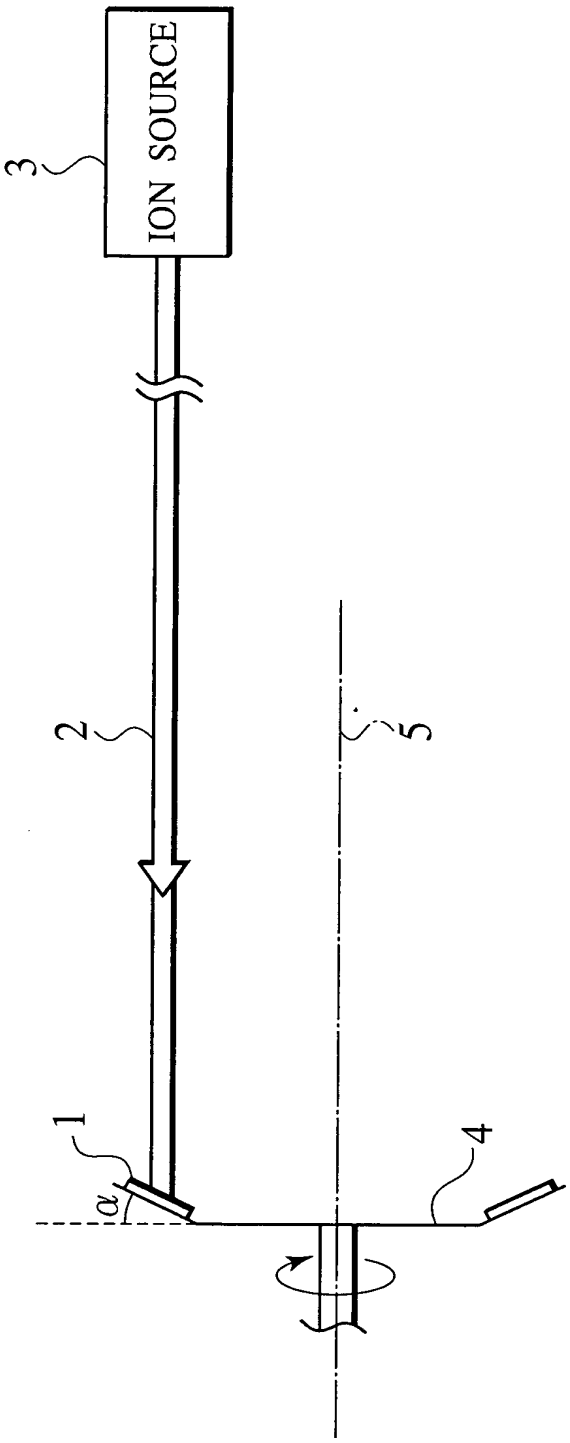

FIG. 2

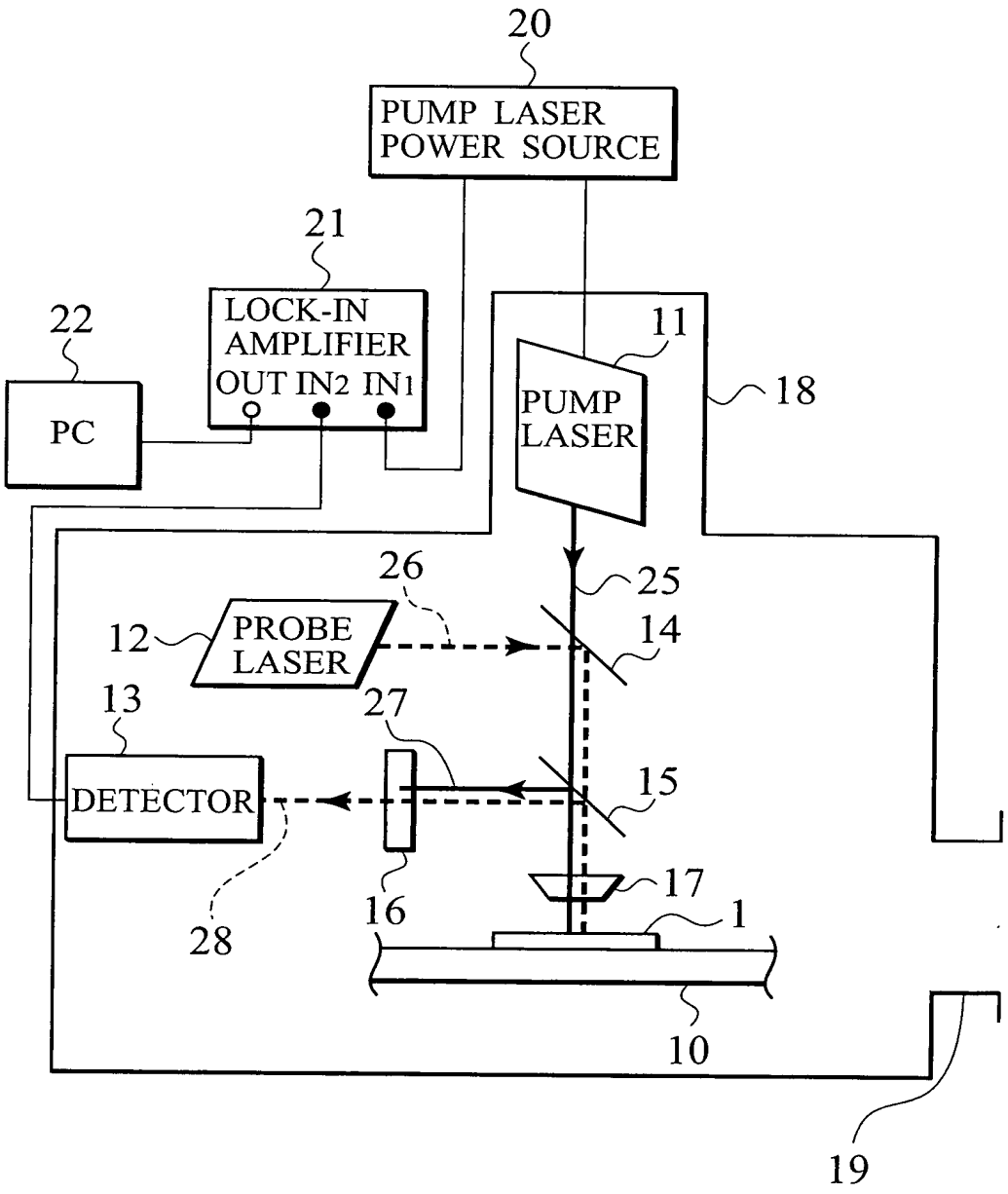
20
PUMP LASER POWER SOURCE
21
LOCK-IN AMPLIFIER
OUT IN2 IN1
22
PC
11
PUMP LASER
18
26
25
12
PROBE LASER
14
13
27
DETECTOR
15
17
16
1
28
10
19

FIG. 3

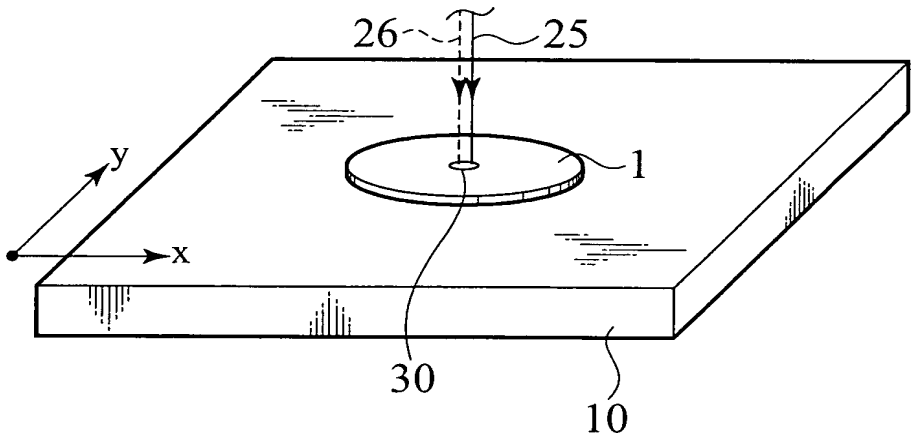

FIG. 4

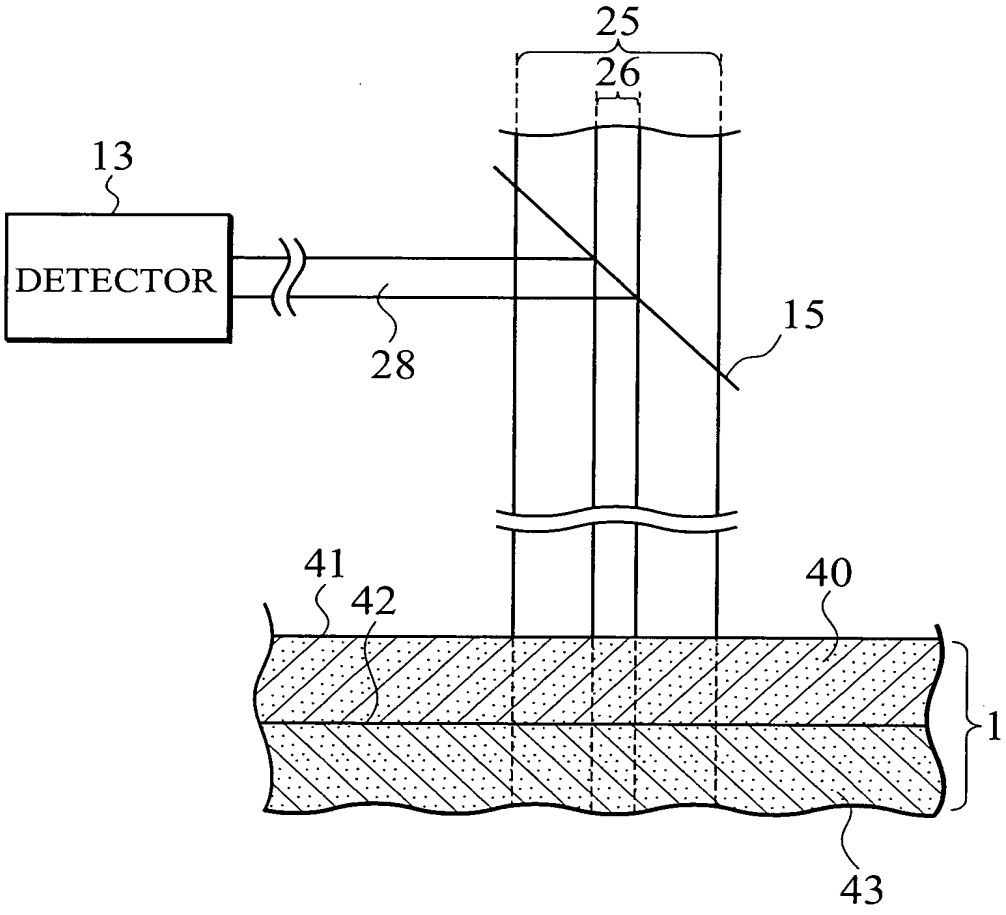

FIG. 5

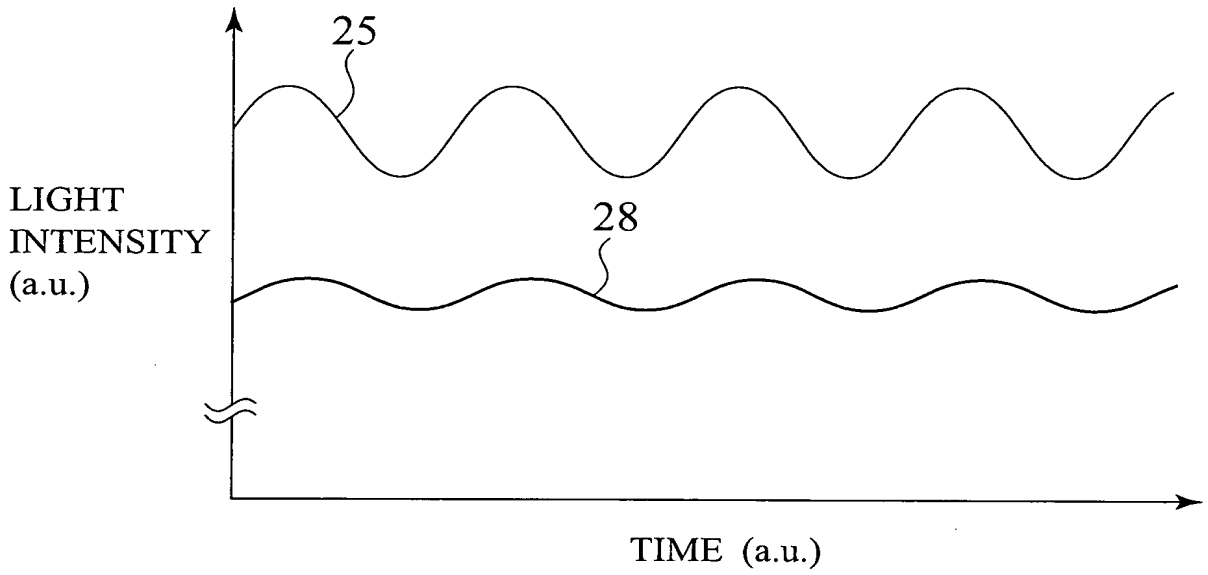

FIG. 6

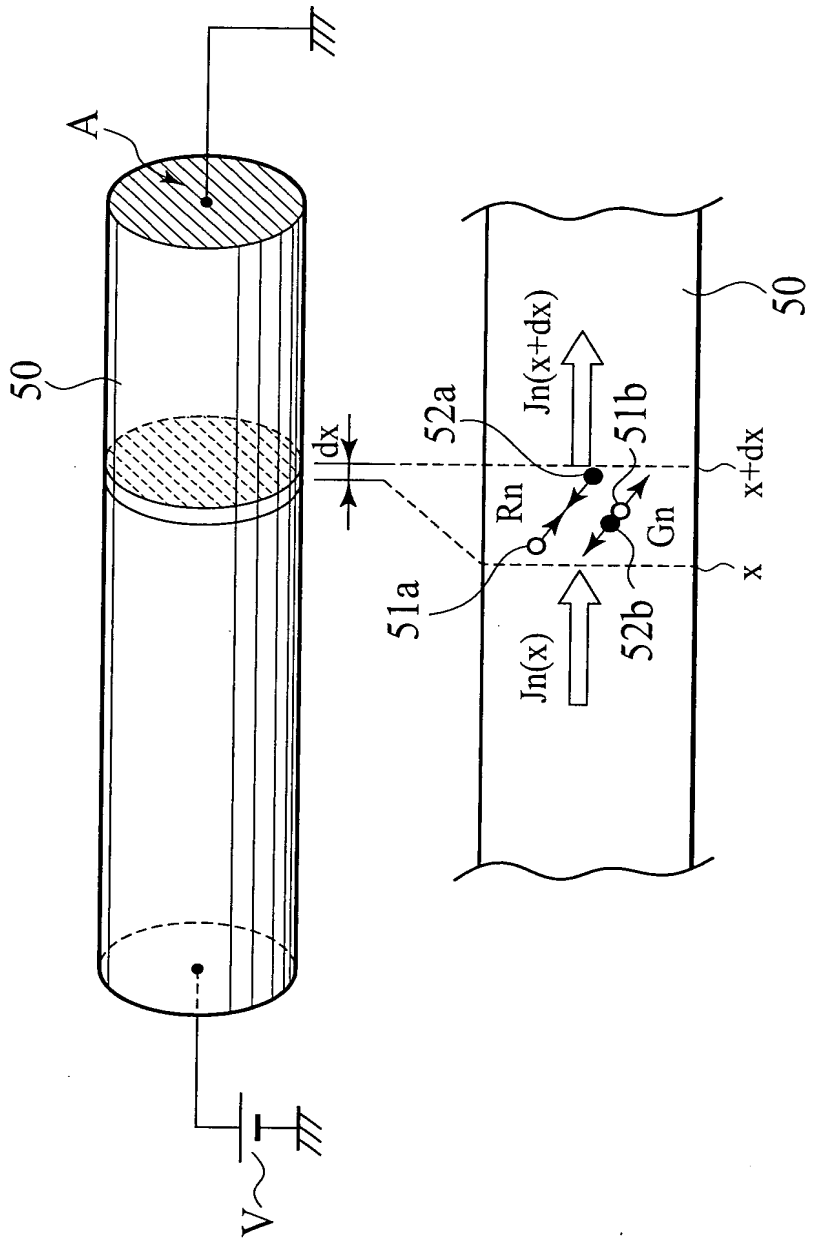

FIG. 7

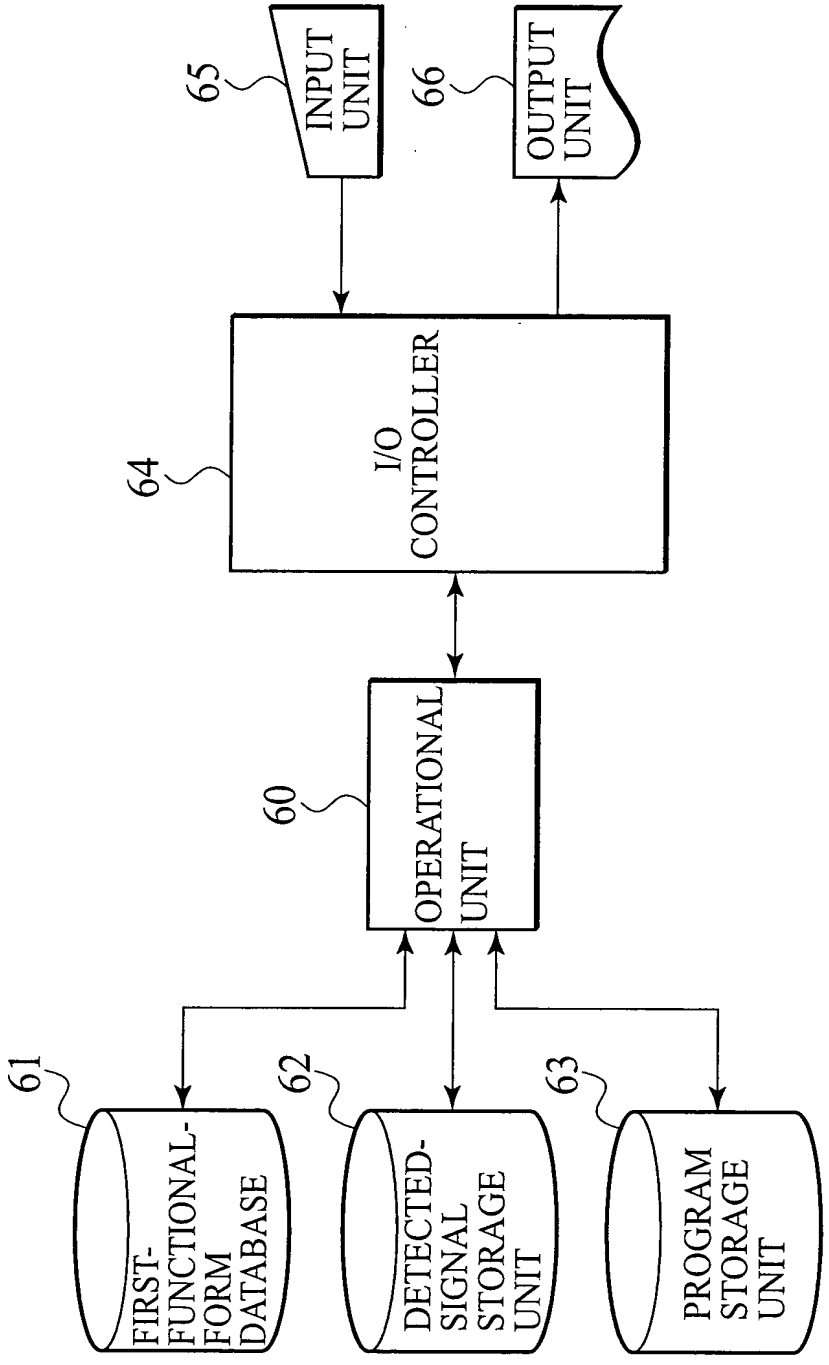
65
INPUT UNIT
66
OUTPUT UNIT
64
I/O CONTROLLER
60
OPERATIONAL UNIT
61
FIRST-FUNCTIONAL-FORM DATABASE
62
DETECTED-SIGNAL STORAGE UNIT
63
PROGRAM STORAGE UNIT

FIG. 8

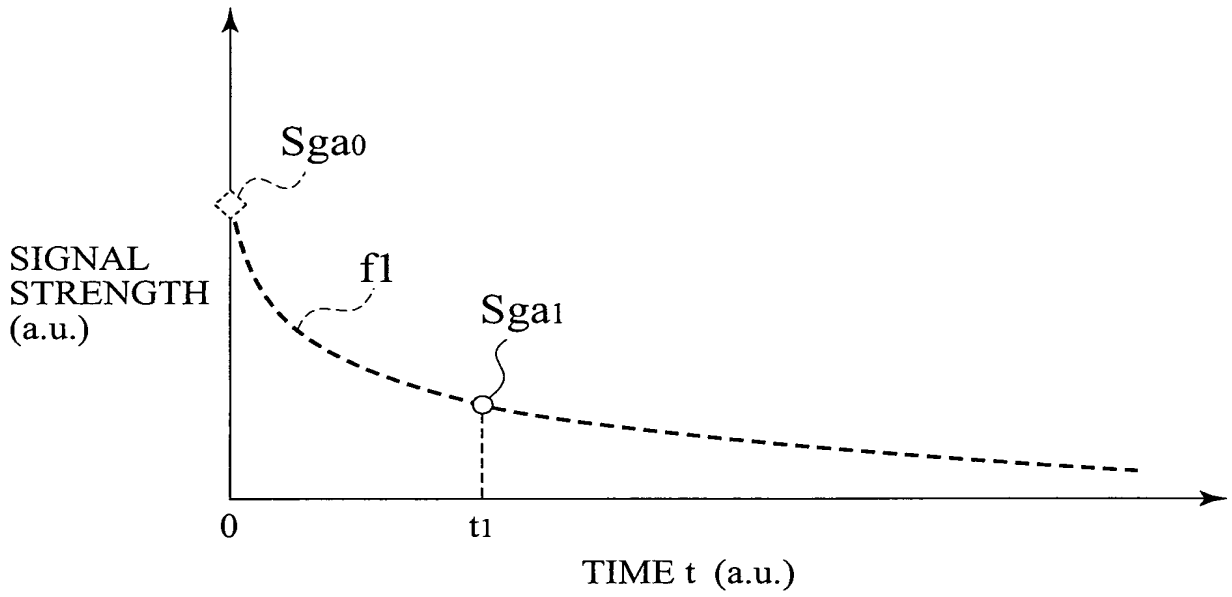

FIG. 9

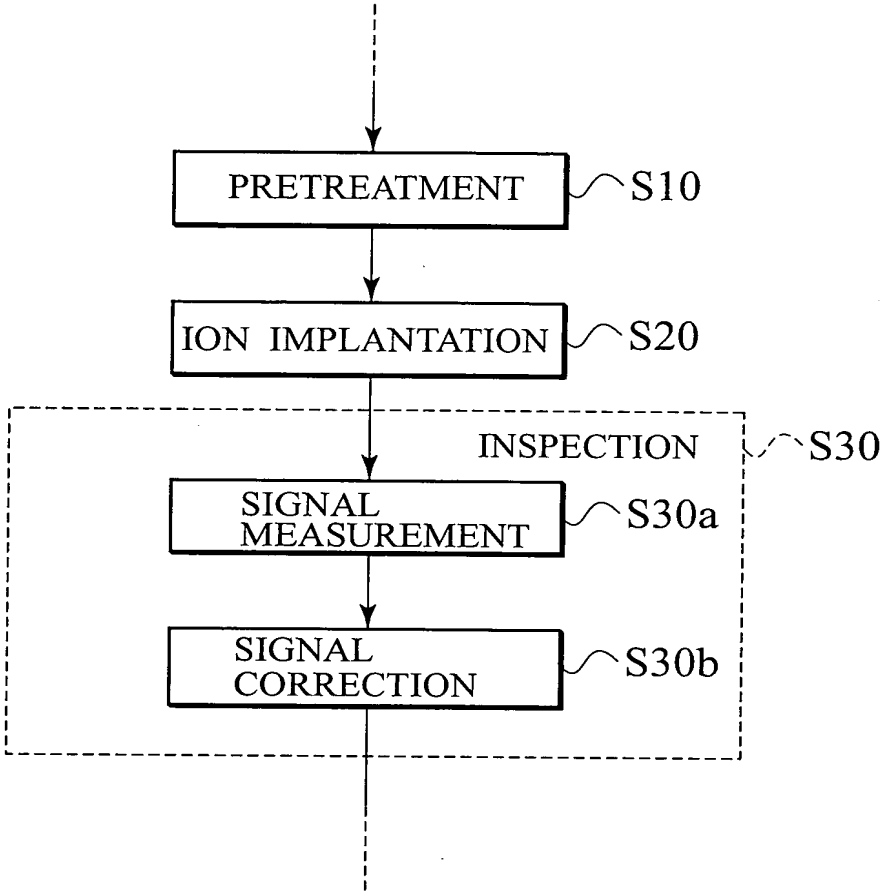
PRETREATMENT
S10
ION IMPLANTATION
S20
INSPECTION
S30
SIGNAL MEASUREMENT
S30a
SIGNAL CORRECTION
S30b

FIG. 10

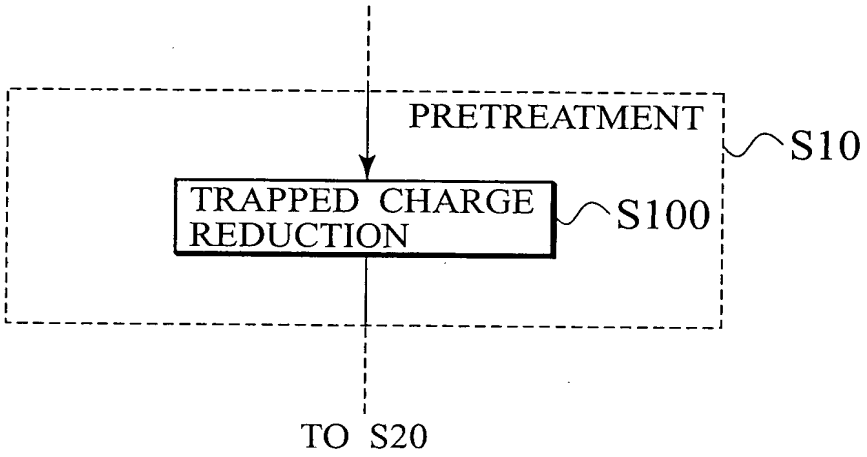
PRETREATMENT
S10
TRAPPED CHARGE REDUCTION
S100
TO S20

FIG. 11

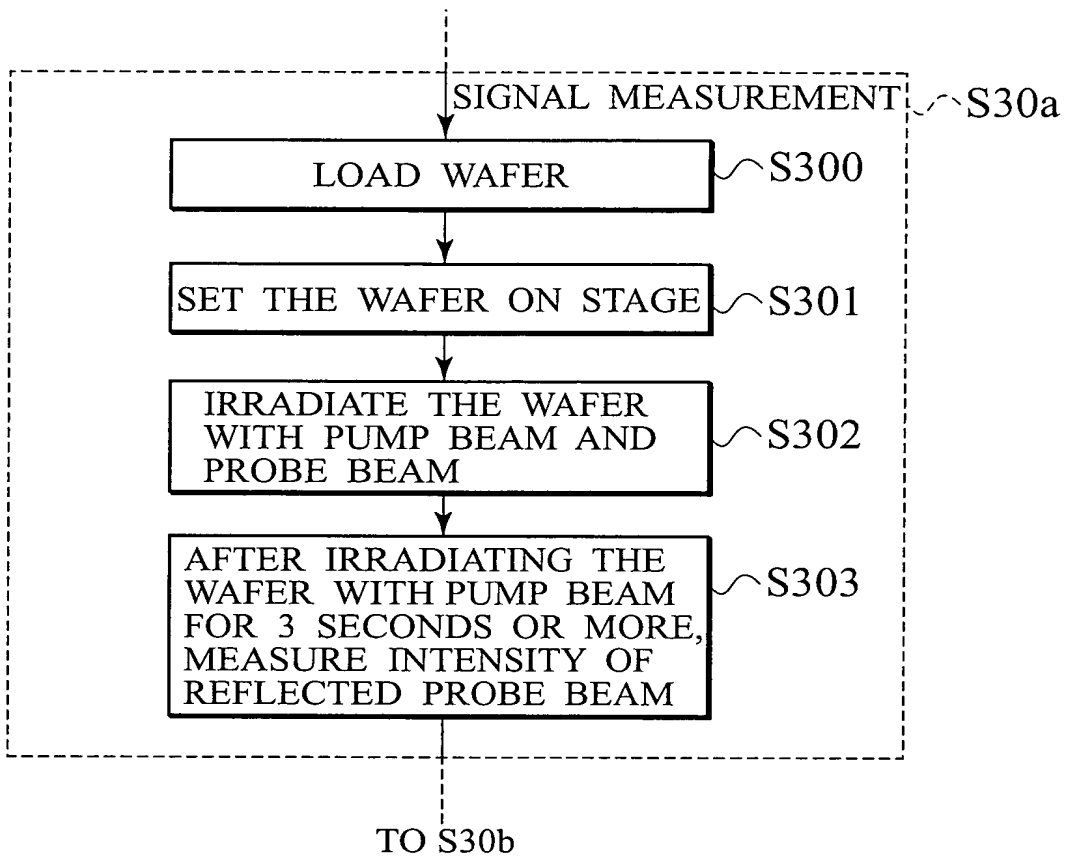
FROM S20
SIGNAL MEASUREMENT
S30a
LOAD WAFER
S300
SET THE WAFER ON STAGE
S301
IRRADIATE THE WAFER WITH PUMP BEAM AND PROBE BEAM
S302
AFTER IRRADIATING THE WAFER WITH PUMP BEAM FOR 3 SECONDS OR MORE, MEASURE INTENSITY OF REFLECTED PROBE BEAM
S303
TO S30b

FIG. 12

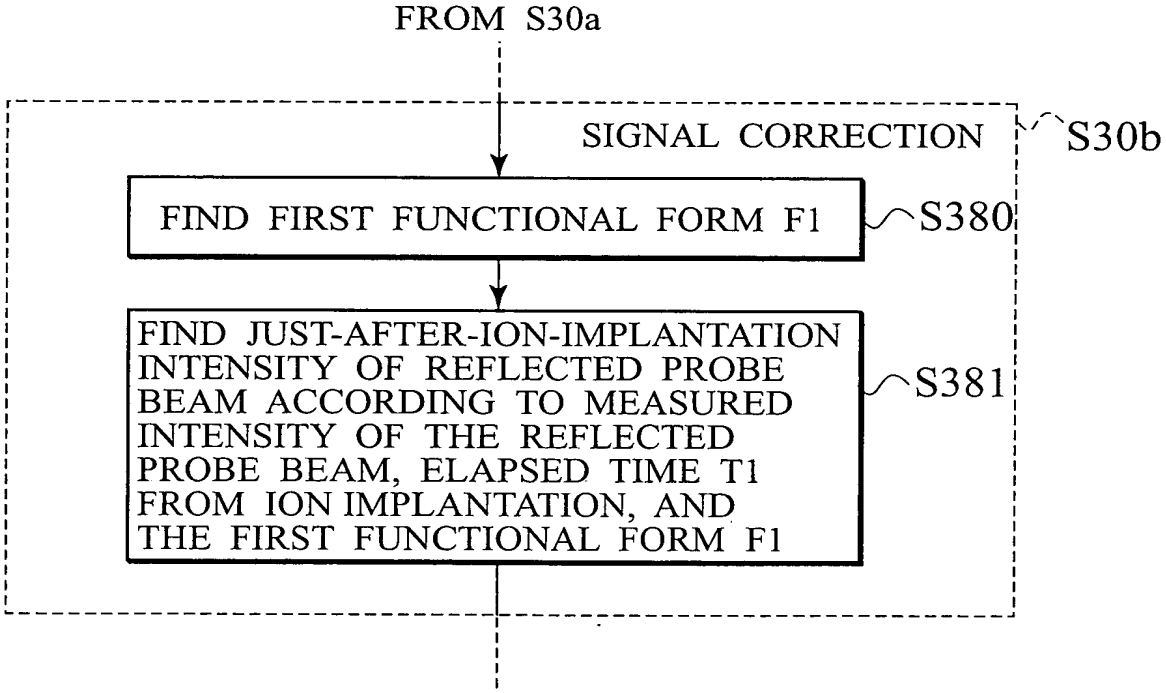
FROM S30a
SIGNAL CORRECTION
S30b
FIND FIRST FUNCTIONAL FORM F1
S380
FIND JUST-AFTER-ION-IMPLANTATION INTENSITY OF REFLECTED PROBE BEAM ACCORDING TO MEASURED INTENSITY OF THE REFLECTED PROBE BEAM, ELAPSED TIME T1 FROM ION IMPLANTATION, AND THE FIRST FUNCTIONAL FORM F1
S381

FIG. 13

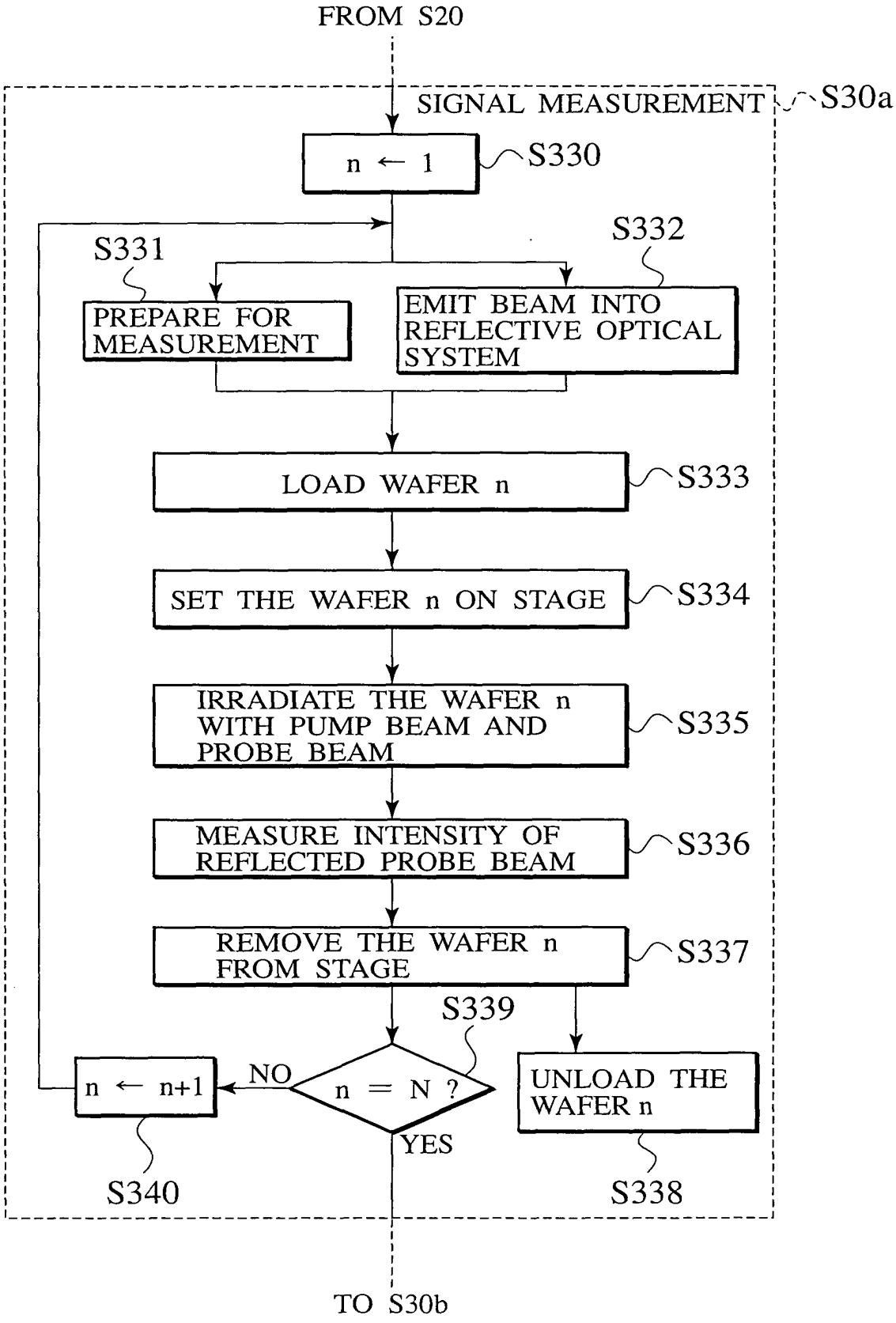
FROM S20
SIGNAL MEASUREMENT
S30a
n ← 1
S330
S331
S332
PREPARE FOR MEASUREMENT
EMIT BEAM INTO REFLECTIVE OPTICAL SYSTEM
LOAD WAFER n
S333
SET THE WAFER n ON STAGE
S334
IRRADIATE THE WAFER n WITH PUMP BEAM AND PROBE BEAM
S335
MEASURE INTENSITY OF REFLECTED PROBE BEAM
S336
REMOVE THE WAFER n FROM STAGE
S337
S339
n = N ?
NO
YES
n ← n+1
S340
UNLOAD THE WAFER n
S338
TO S30b

FIG. 14A

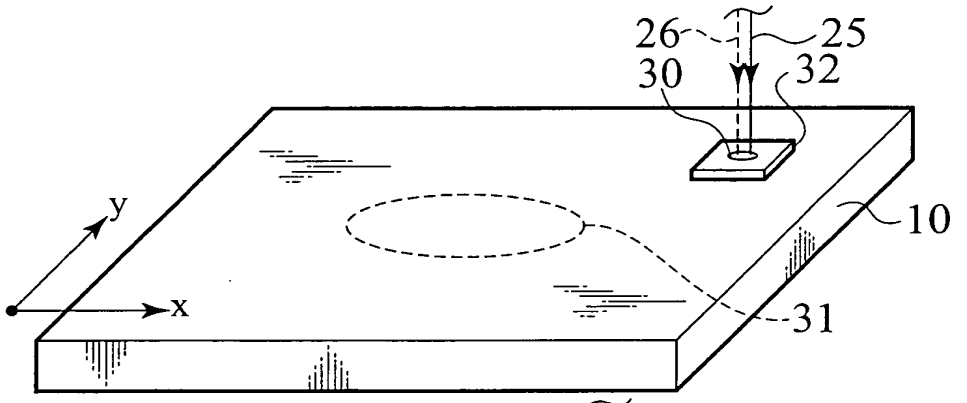

FIG. 14B

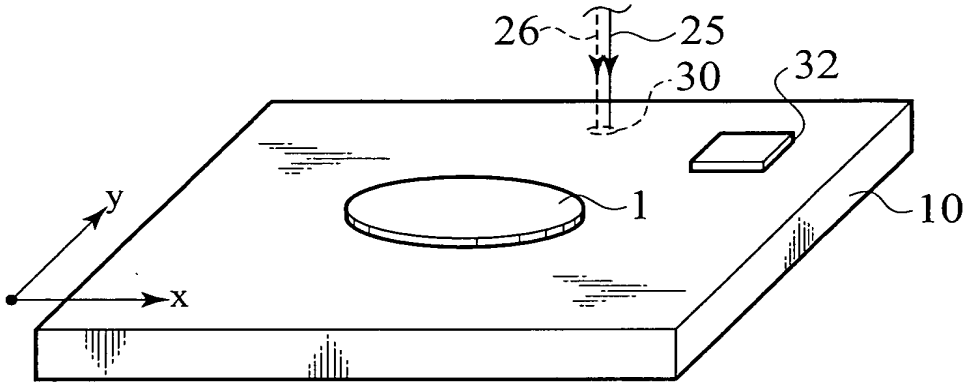

FIG. 14C

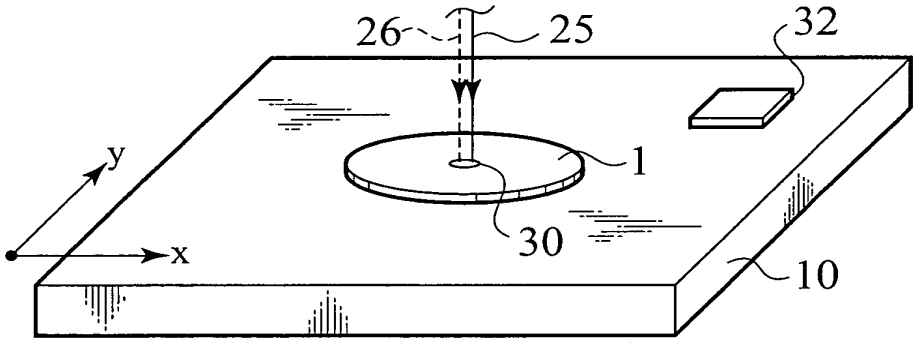

FIG. 14D

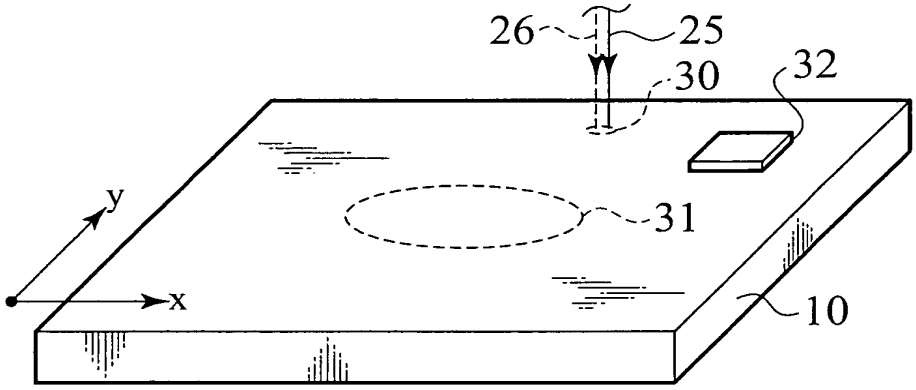

FIG. 15

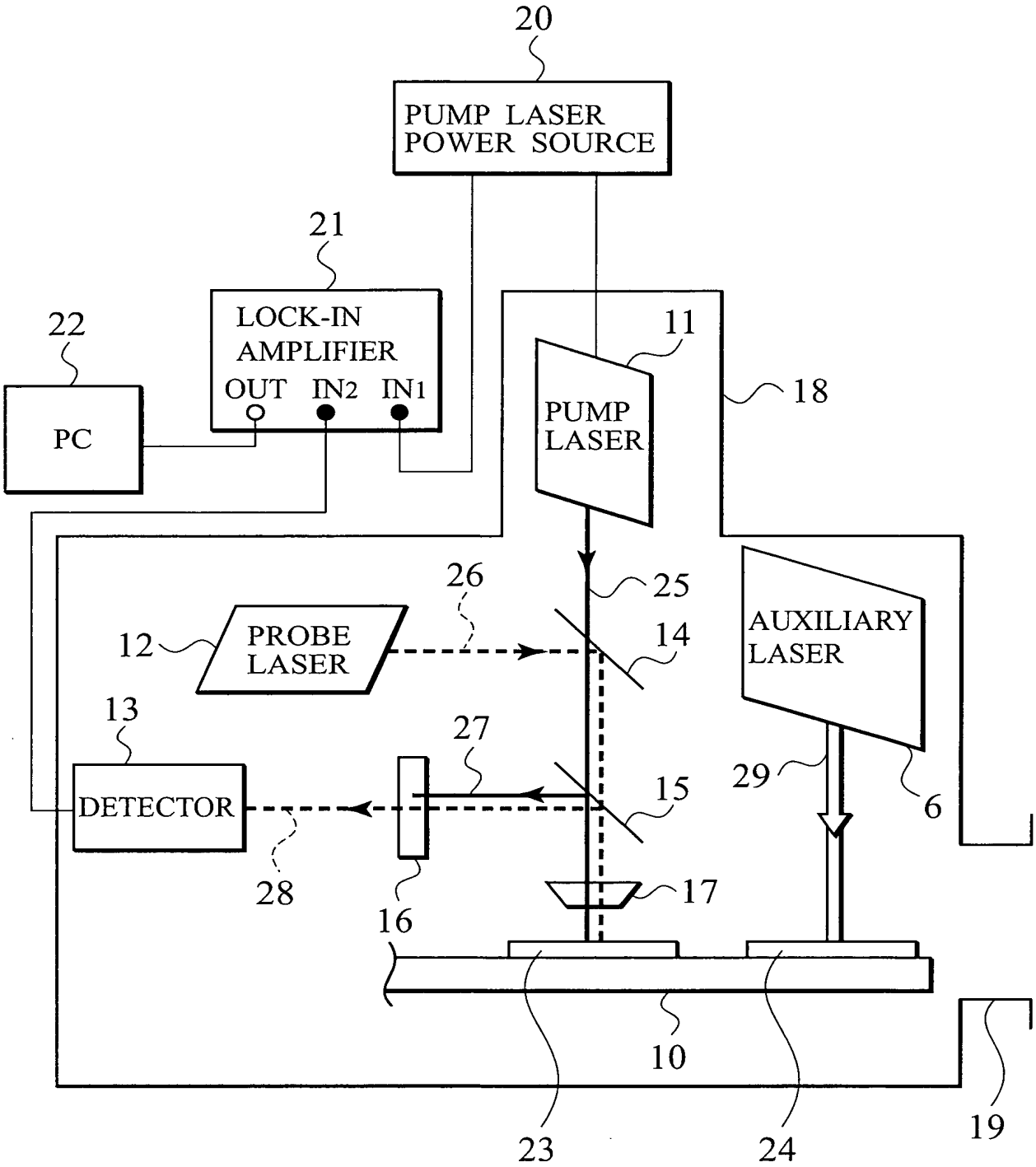
20
PUMP LASER POWER SOURCE
21
LOCK-IN AMPLIFIER
OUT IN2 IN1
22
PC
11
PUMP LASER
18
26
25
12
PROBE LASER
14
AUXILIARY LASER
13
27
29
DETECTOR
15
6
28
16
17
10
23
24
19

FIG. 16

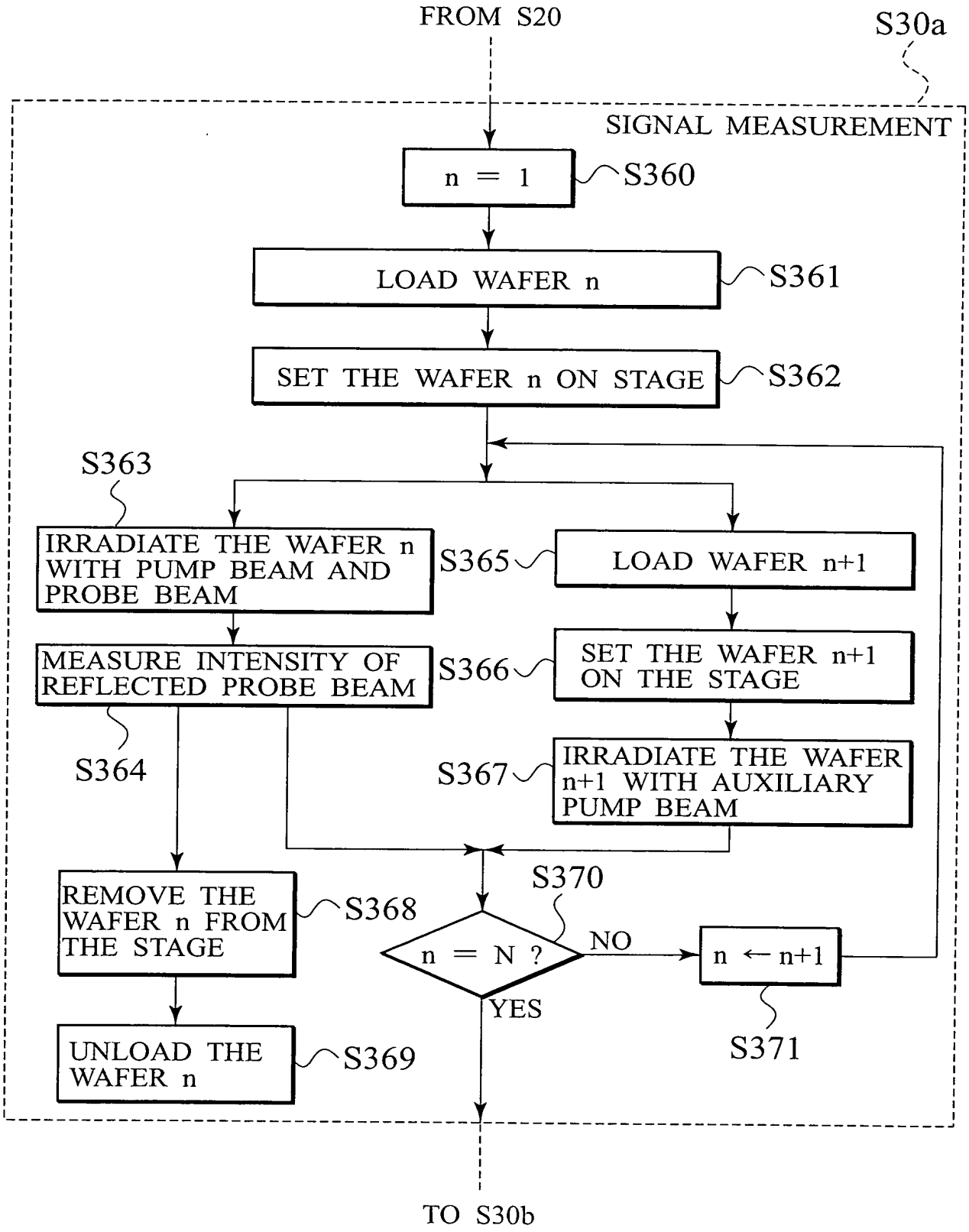
FROM S20
S30a
SIGNAL MEASUREMENT
n = 1
S360
LOAD WAFER n
S361
SET THE WAFER n ON STAGE
S362
S363
IRRADIATE THE WAFER n WITH PUMP BEAM AND PROBE BEAM
S365
LOAD WAFER n+1
MEASURE INTENSITY OF REFLECTED PROBE BEAM
S366
SET THE WAFER n+1 ON THE STAGE
S364
S367
IRRADIATE THE WAFER n+1 WITH AUXILIARY PUMP BEAM
S370
REMOVE THE WAFER n FROM THE STAGE
S368
n = N ?
NO
n ← n+1
YES
S371
UNLOAD THE WAFER n
S369
TO S30b

FIG. 17

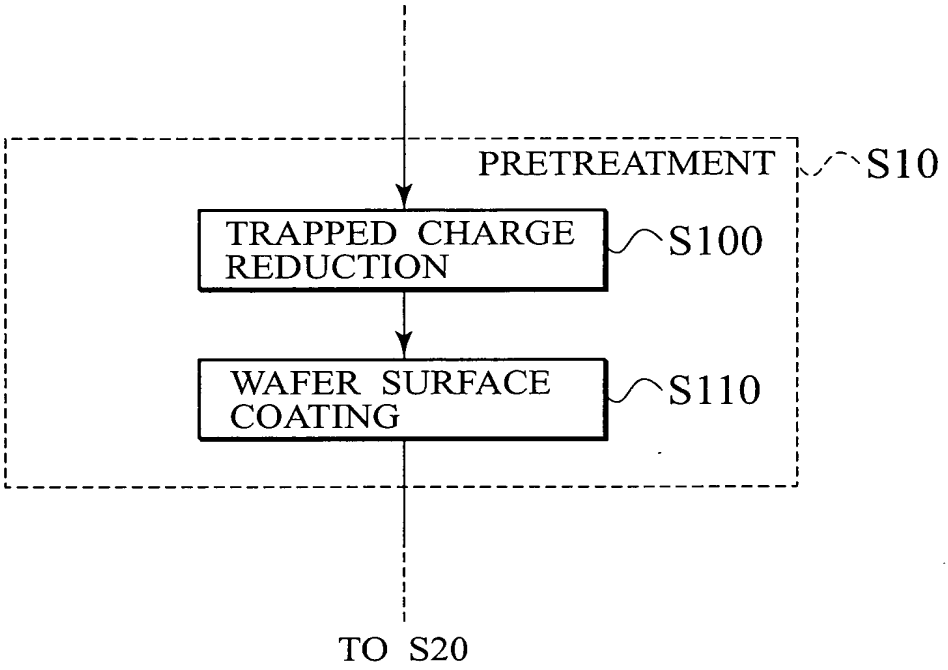
PRETREATMENT
S10
TRAPPED CHARGE REDUCTION
S100
WAFER SURFACE COATING
S110
TO S20

FIG. 18

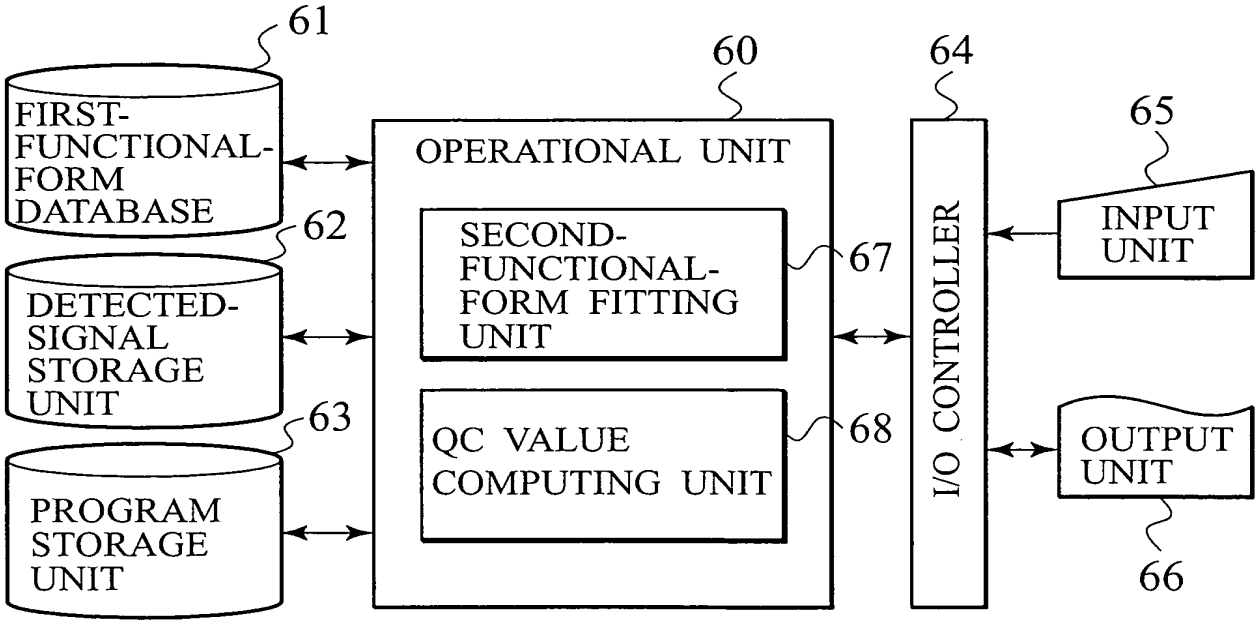
61
FIRST-FUNCTIONAL-FORM DATABASE
62
DETECTED-SIGNAL STORAGE UNIT
63
PROGRAM STORAGE UNIT
60
OPERATIONAL UNIT
SECOND-FUNCTIONAL-FORM FITTING UNIT
67
QC VALUE COMPUTING UNIT
68
64
I/O CONTROLLER
65
INPUT UNIT
OUTPUT UNIT
66

FIG. 19

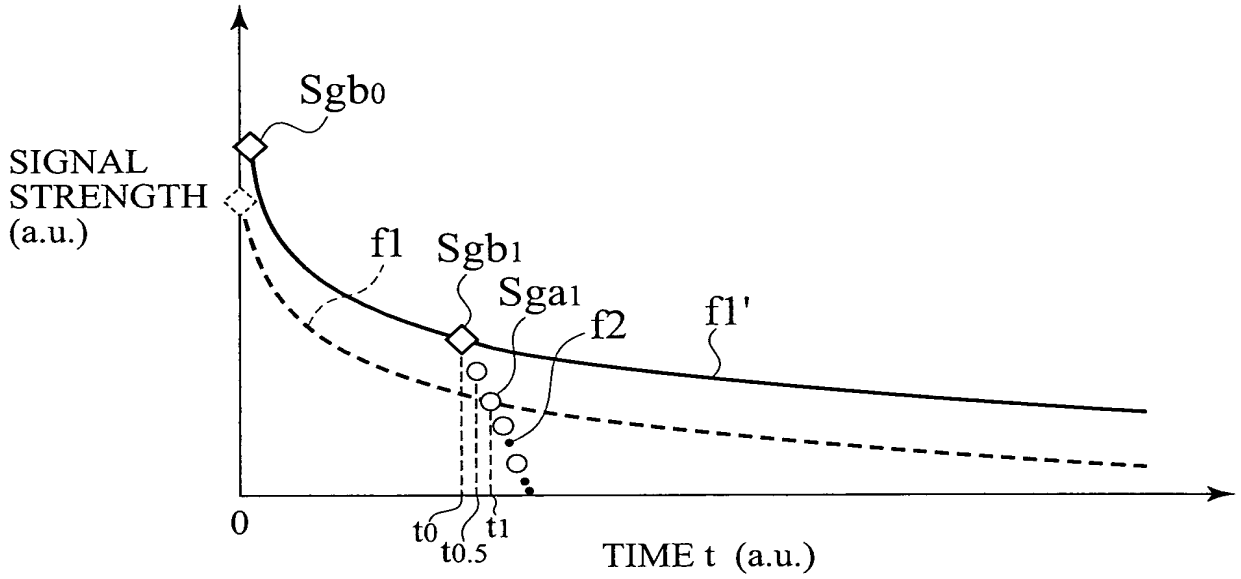

FIG. 20

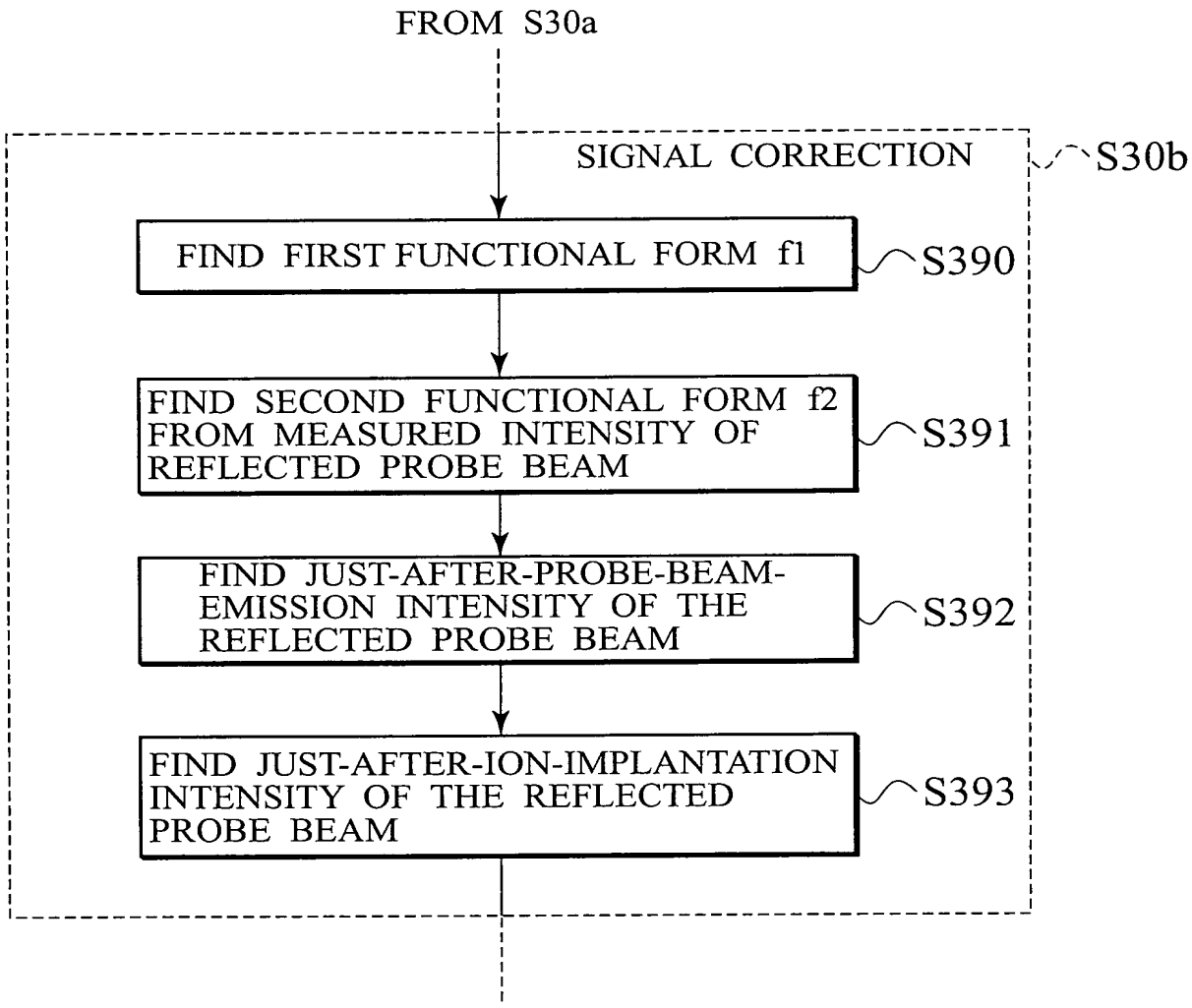
FROM S30a
SIGNAL CORRECTION
S30b
FIND FIRST FUNCTIONAL FORM f1
S390
FIND SECOND FUNCTIONAL FORM f2 FROM MEASURED INTENSITY OF REFLECTED PROBE BEAM
S391
FIND JUST-AFTER-PROBE-BEAM-EMISSION INTENSITY OF THE REFLECTED PROBE BEAM
S392
FIND JUST-AFTER-ION-IMPLANTATION INTENSITY OF THE REFLECTED PROBE BEAM
S393

FIG. 21

OXIDE FILM THICKNESS	IONIC SPECIES	ACCELERATION ENERGY	DOSE	ANGLE	ION IMPLANTER	IN-PLANE UNIFORMITY OF SIGNAL STRENGTH CONVERTED INTO DOSE (%) STANDARD DEVIATION (DOSE) %
8nm	P	500keV	5E+13	+2°	C	0.65
8nm	P	500keV	5E+13	PARALLEL	C	0.38
8nm	P	500keV	5E+13	-2°	C	0.51
8nm	P	500keV	5E+13	-5°	C	2.42

FIG. 22

IONIC SPECIES	ACCELERATION ENERGY	DOSE	ANGLE	ION IMPLANTER	IN-PLANE UNIFORMITY OF SIGNAL STRENGTH CONVERTED INTO DOSE (%) STANDARD DEVIATION (DOSE) %
B	3keV	3E+15	'+2°	A	0.483694052
B	3keV	3E+15	PARALLEL	A	0.602034279
B	3keV	3E+15	'-2°	A	0.633528518

FIG. 23

TILT ANGLE	TWIST ANGLE	IN-PLANE UNIFORMITY IN DOSE (%)	
0	0	1.01	
0	0	1.35	
7	0	1.24	
5	180	1.36	← ION BEAM AND WHEEL ROTATION AXIS ARE PARALLEL
7	180	1.77	
9	180	2.71	
7	203	1.40	
5	210	0.874	
5	225	1.16	
5	240	0.913	
7	247	2.75	
5	255	0.54	← IMPLANTING CONDITIONS TO REDUCE CIRCUMFERENTIAL ANGULAR VARIATIONS
5	270	0.60	
7	270	1.43	

FIG. 24

OXIDE FILM THICKNESS	IONIC SPECIES	ACCELERATION ENERGY	DOSE	ANGLE	ION IMPLANTER	IN-PLANE UNIFORMITY OF SIGNAL STRENGTH CONVERTED INTO DOSE (%) STANDARD DEVIATION (DOSE) %
8nm	B	30	1E+15	2°	B	1.39
8nm	B	30	1E+15	PARALLEL	B	1.34
8nm	B	30	1E+15	-2°	B	1.10
8nm	B	30	1E+15	-5°	B	0.92

FIG. 25

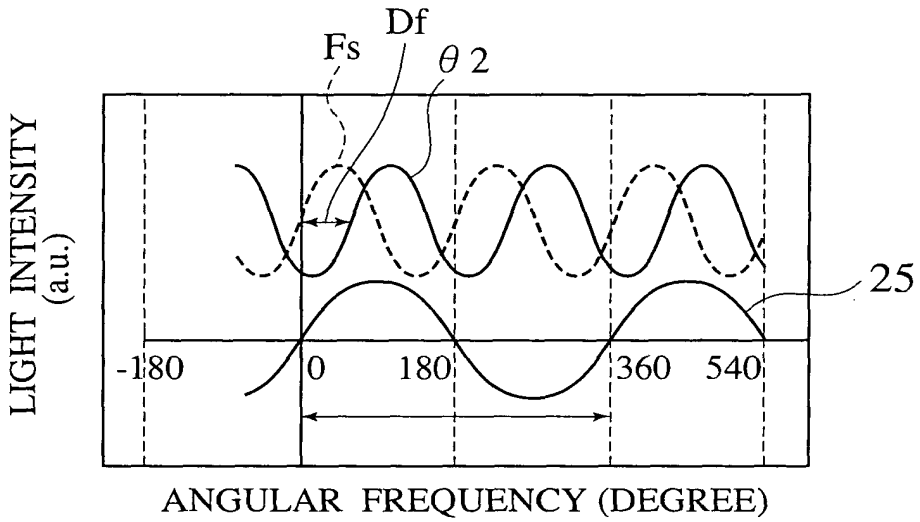

FIG. 26A

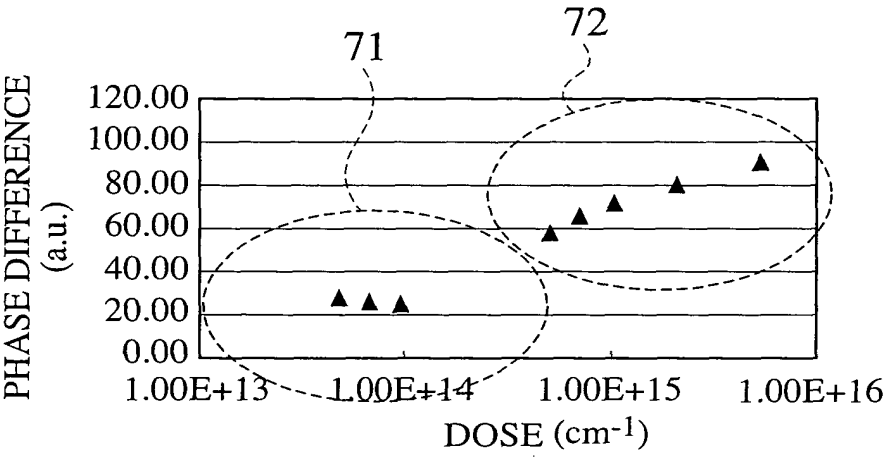

FIG. 26B

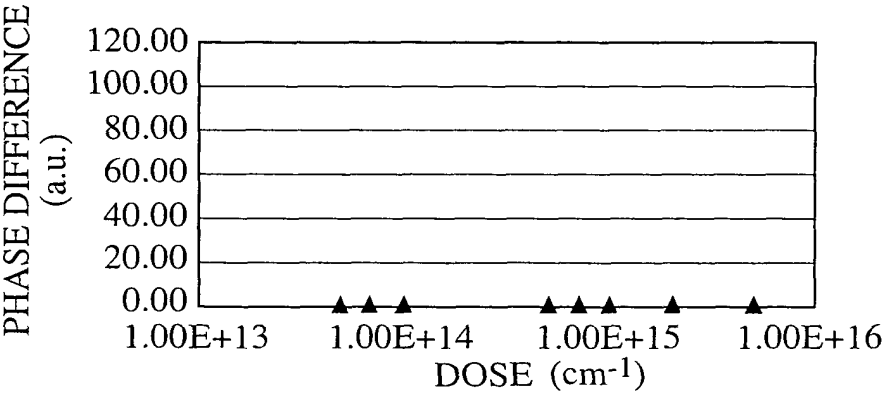

FIG. 27

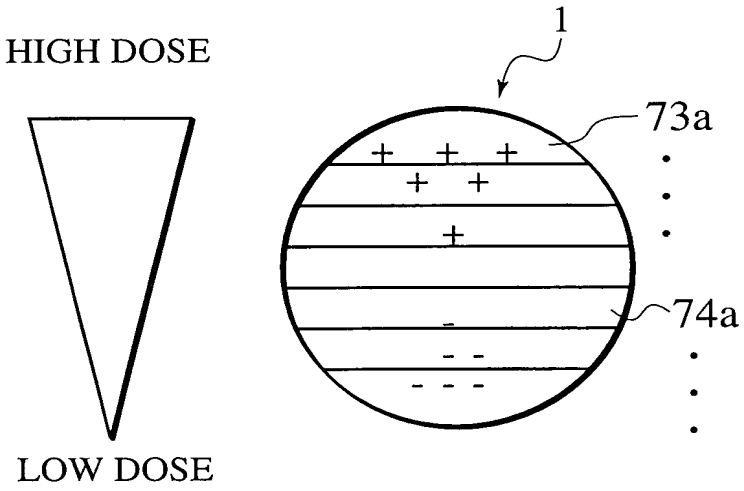

FIG. 28